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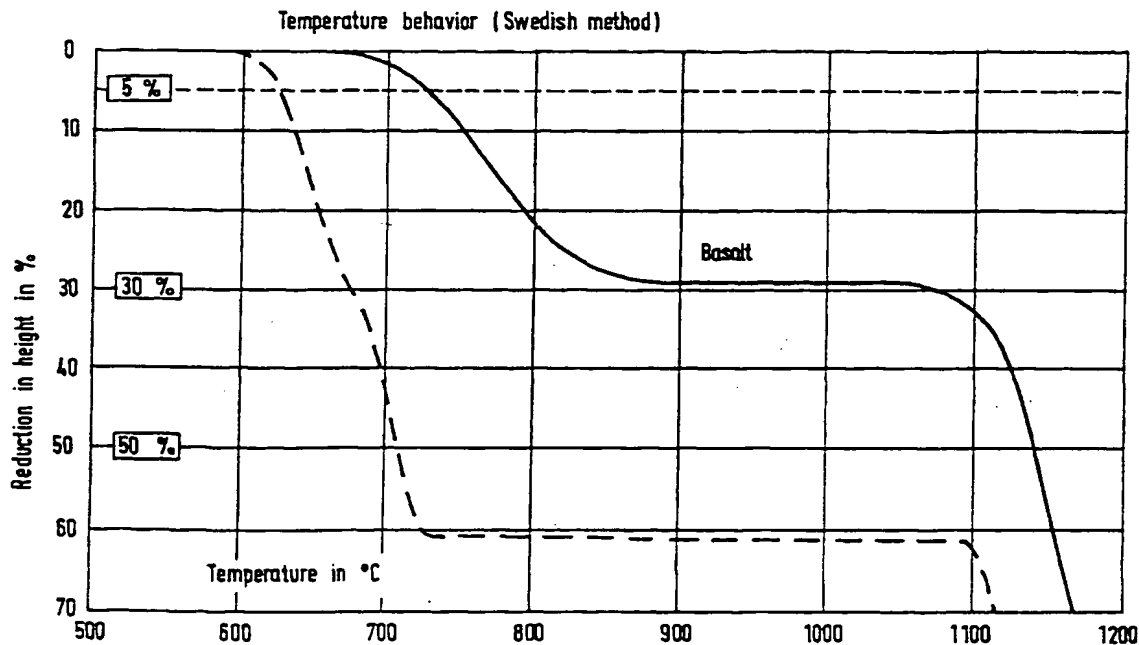
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(54) Title: A MINERAL-FIBER COMPOSITION



(57) Abstract

A biologically degradable mineral-fiber composition characterized by the following constituents in percent by weight: SiO₂ 50 to 65, Al₂O₃ less than 2, CaO 16 to 30, MgO 4 to 15, Na₂O 8 to 20, K₂O 0 to 2, B₂O₃ 0 to 10, TiO₂, Fe₂O₃, Cr₂O₃, BaO, MnO, P₂O₅ 0 to 5.

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A mineral-fiber composition

The present invention relates to a mineral-fiber composition that is biologically degradable.

The prior art describes some mineral-fiber compositions which are said to be biologically degradable.

The biological degradability of mineral-fiber compositions is of great importance because various studies point out that mineral fibers with very small diameters in the range of less than 3 microns are suspected to be carcinogenic, while biologically degradable mineral fibers of such dimensions show lower or no carcinogenicity.

However not only the biological degradability is of crucial importance but also the mechanical and thermal properties of the mineral fibers, or the products produced therefrom, and the processibility of the mineral-fiber composition. For example mineral fibers are used to a great extent for insulation purposes. In particular for this application in the industrial area sufficient temperature stability of the mineral fibers is necessary.

Also, the mineral-fiber composition must permit processibility by known methods for producing mineral fibers with a small diameter, for example the jet process.

The invention is based on the problem of providing a novel mineral-fiber composition that is characterized by biological degradability, has good temperature stability and is easy to process.

The invention is based on the finding that this problem can be solved by a mineral-fiber composition that is built up substantially from silicon oxide, calcium oxide, magnesium oxide and sodium oxide.

It has turned out that such a mineral-fiber composition fulfills the combination of the necessary properties, namely biological degradability, temperature stability and good processibility.

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The object of the invention is a mineral-fiber composition that is biologically degradable, characterized by the following constituents in percent by weight:

| | |
|------------------------------------------------------------------------------------------------------------------------------|-------------|
| SiO ₂ | 50 to 65 |
| Al ₂ O ₃ | less than 2 |
| CaO | 16 to 30 |
| MgO | 4 to 15 |
| Na ₂ O | 8 to 20 |
| K ₂ O | 0 to 2 |
| B ₂ O ₃ | 0 to 10 |
| TiO ₂ , Fe ₂ O ₃ , Cr ₂ O ₃ , BaO, MnO, P ₂ O ₅ | 0 to 5 |

The inventive mineral-fiber compositions are drawable by the jet process or the rotary process. The obtained fibers have good temperature stability. Surprisingly enough, the mineral-fiber compositions show biological degradability. The mean fiber diameter is preferably 10 microns or less, and especially between 2.5 and 5 microns.

The inventive mineral-fiber compositions preferably have the following constituents in percent by weight:

| | |
|------------------------------------------------------------------------------------------------------------------------------|---------------|
| SiO ₂ | 55 to 60 |
| Al ₂ O ₃ | less than 1.5 |
| CaO | 16 to 25 |
| MgO | 5 to 15 |
| Na ₂ O | 9 to 15 |
| K ₂ O | less than 2 |
| B ₂ O ₃ | 0 to 8 |
| TiO ₂ , Fe ₂ O ₃ , Cr ₂ O ₃ , BaO, MnO, P ₂ O ₅ | 0 to 5 |

In particular, the inventive mineral-fiber compositions have the following constituents in percent by weight:

| | |
|------------------------------------------------------------------------------------------------------------------------------|---------------|
| SiO ₂ | 55 to 59 |
| Al ₂ O ₃ | less than 1.5 |
| CaO | 18 to 23 |
| MgO | 8 to 12 |
| Na ₂ O | 9 to 13 |
| K ₂ O | less than 1 |
| B ₂ O ₃ | 0 to 3 |
| TiO ₂ , Fe ₂ O ₃ , Cr ₂ O ₃ , BaO, MnO, P ₂ O ₅ | 0 to 3 |

The content of magnesium oxide is preferably 6 to 12 percent by weight and in particular 8 to 12 percent by weight.

The content of chromium oxide is preferably less than 1.5 percent by weight and in particular less than 1.0 percent by weight.

The content of boron oxide is preferably less than 4 percent by weight.

To assess biological degradability the standard powder test of the German Glass Society was used. This is an easily conducted method and gives a sufficient measure of biological degradability. The method is described in L. Springer, "Laboratoriumsbuch für die Glasindustrie", 3rd edition, 1950, Halle/S: W. Knapp Verlag.

The temperature behavior of the mineral fibers was determined by the Swedish method. In this method a silit tube furnace is used with a horizontal working tube open on both sides having a length of 350 mm and an inside diameter of 27 mm. In the center of the furnace there is a small ceramic supporting plate (30 X 20 X 3 mm) for holding the test sample. The test sample has dimensions of 12 X 12 X 12 mm or 12 mm ϕ X 12 mm height. The bulk density is normally 100 kg/m³. The temperature increase is 5 K/min. The change in test sample height is determined continuously with a reading optic.

The invention shall be described in more detail in the following with reference to examples.

Example 1

A mineral wool of the following composition in percent by weight was produced:

| | |
|--------------------------------|-----|
| SiO ₂ | 56 |
| Al ₂ O ₃ | 0.5 |
| CaO | 20 |
| MgO | 10 |
| Na ₂ O | 10 |
| B ₂ O ₃ | 2.7 |

This composition could be processed well to mineral fibers with a mean diameter of 2.5 microns by the jet process at a drawing temperature of 1330°C.

An investigation according to the standard powder test of the German Glass Society yielded a value of 35 mg/kg and thus a value for high biological degradability.

Determination of temperature behavior by the Swedish method yielded a temperature stability at 5% reduction in height of 620°C, which can be clearly seen from the corresponding diagram shown by way of example in the single drawing.

Example 2

A mineral wool with the following composition in percent by weight was produced:

| | <u>% by weight</u> | <u>Mole %</u> |
|--------------------------------|--------------------|---------------|
| SiO ₂ | 56 | 52.75 |
| Al ₂ O ₃ | 1.0 | 0.55 |
| CaO | 21 | 21.20 |
| MgO | 11 | 15.45 |
| Na ₂ O | 11 | 10.05 |

This composition could be processed well to mineral fibers with a mean diameter of 2.7 microns by the jet process at a drawing temperature of 1310°C.

An investigation according to the standard powder test of the German Glass Society yielded a value of 37 mg/kg and thus a value for high biological degradability.

Determination of temperature behavior by the Swedish method yielded a temperature stability at 5% reduction in height of 600°C.

Claims

1. A mineral-fiber composition that is biologically degradable, characterized by the following constituents in percent by weight:

| | | |
|------------------------------------------------------------------------------------------------------------------------------|-------------|-------|
| SiO ₂ | 50 | to 65 |
| Al ₂ O ₃ | less than 2 | |
| CaO | 16 | to 30 |
| MgO | 4 | to 15 |
| Na ₂ O | 8 | to 20 |
| K ₂ O | 0 | to 2 |
| B ₂ O ₃ | 0 | to 10 |
| TiO ₂ , Fe ₂ O ₃ , Cr ₂ O ₃ , BaO, MnO, P ₂ O ₅ | 0 | to 5 |

2. The mineral-fiber composition of claim 1, characterized by the following constituents in percent by weight:

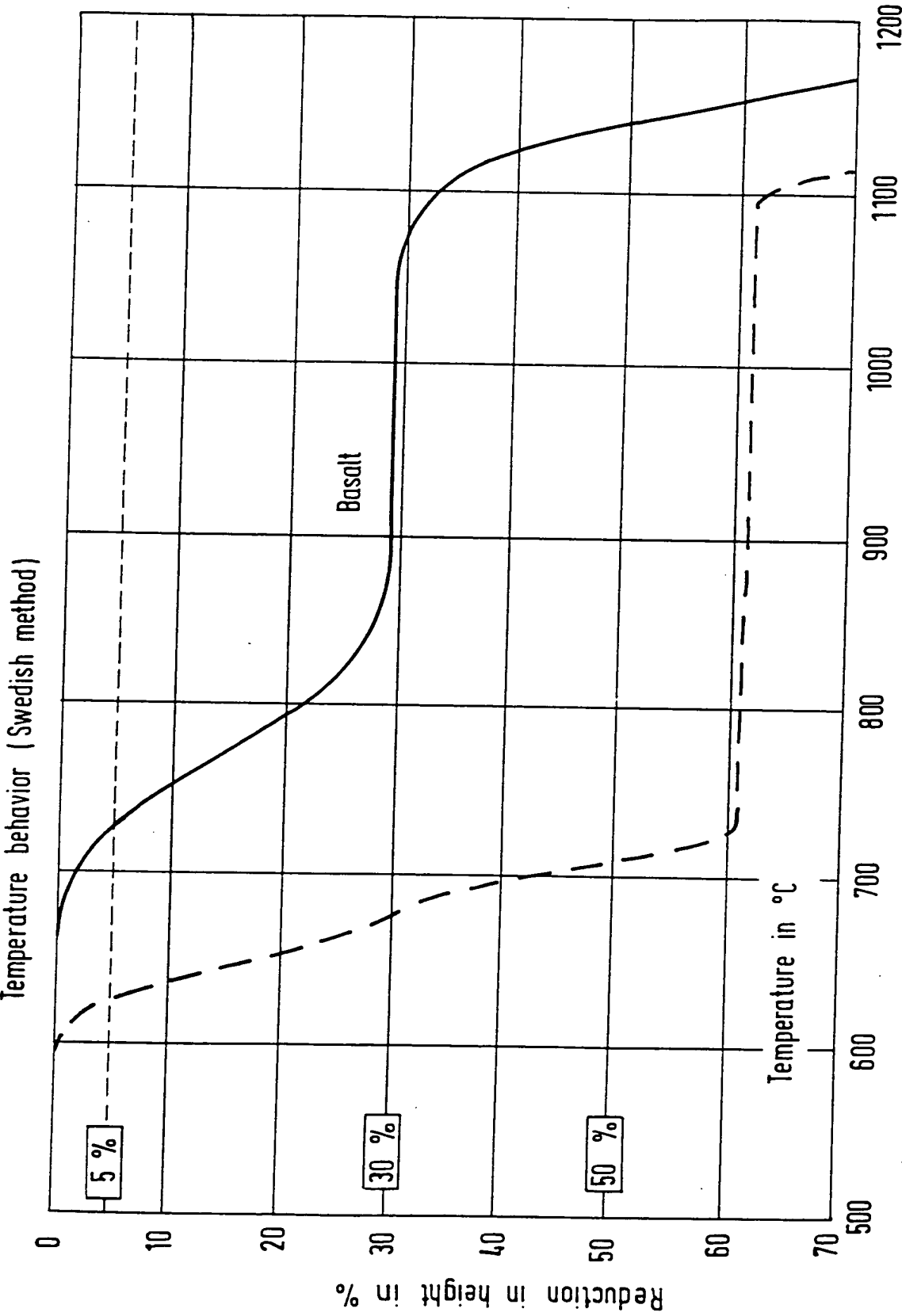
| | | |
|------------------------------------------------------------------------------------------------------------------------------|---------------|-------|
| SiO ₂ | 55 | to 60 |
| Al ₂ O ₃ | less than 1.5 | |
| CaO | 16 | to 25 |
| MgO | 5 | to 15 |
| Na ₂ O | 9 | to 15 |
| K ₂ O | less than 2 | |
| B ₂ O ₃ | 0 | to 8 |
| TiO ₂ , Fe ₂ O ₃ , Cr ₂ O ₃ , BaO, MnO, P ₂ O ₅ | 0 | to 5 |

3. The mineral-fiber composition of claim 1, characterized by the following constituents in percent by weight:

| | | |
|------------------|----|-------|
| SiO ₂ | 55 | to 59 |
|------------------|----|-------|

| | |
|---------------------------------------------------------------------------------------------------------------------------|---------------|
| Al_2O_3 | less than 1.5 |
| CaO | 18 to 23 |
| MgO | 8 to 12 |
| Na_2O | 9 to 13 |
| K_2O | less than 1 |
| B_2O_3 | 0 to 3 |
| TiO_2 , Fe_2O_3 , Cr_2O_3 , BaO , MnO , P_2O_5 | 0 to 3 |

4. The mineral-fiber composition of any of claims 1 to 3, characterized in that the content of boron oxide is less than 4 percent by weight.



INTERNATIONAL SEARCH REPORT

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PCT/EP 95/01843

A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|-----------------------------------------------------------------------------------------------------------|-----------------------|
| A | WO,A,89 12032 (MANVILLE SALES CORPORATION) 14 December 1989 see page 5 - page 6; example 225 --- | 1-4 |
| A | FR,A,2 690 438 (ISOVER SAINT-GOBAIN) 29 October 1993 see claim 1; example 2 --- | 1-4 |
| A | WO,A,92 09536 (PAROC OY AB) 11 June 1992 see claims ----- | 1-4 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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